

SEMICONDUCTOR DEVICE

BACKGROUND OF THE INVENTION

FIG. 11 is a plan view showing a layout of a known semiconductor device in which
5 a large number of MIS transistors (hereinafter, referred to as MISFETs) are arranged. As
shown in FIG. 11, various types of active regions in which mutually different numbers of
MISFETs are arranged at mutually different densities are provided in the semiconductor
device, being surrounded by a trench isolation **Ris**. Hereinafter, an active region in which
gates **101** of three or more respective MISFETs are continuously arranged without being
10 separated by the trench isolation **Ris** will be referred to as a continuous active region **R101**,
an active region in which only a gate **104** of a MISFET is placed will be referred to as a
discontinuous active region **R102**, and an active region in which gates **106** of two
respective MISFETs are disposed will be referred to as two-input active region **R103**.
Dummy gates **107** are arranged on the trench isolation **Ris** of the semiconductor device so
15 as to increase the accuracy in patterning for gates using a line-and-space pattern.

In addition, as shown in FIG. 11, a distance **L101** between one of the gates **101** of
the MISFETs located at each end thereof in the continuous active region **R101** and the
trench isolation **Ris**, a distance **L102** between the gate electrode **104** of the MISFET in the
discontinuous active region **R102** and the trench isolation **Ris**, and a distance **L103**
20 between each of the gates **106** of the MISFETs in the two-input active region **R103** and the
trench isolation **Ris**, differ from one another.

In this manner, the known semiconductor device is configured to have a layout in
which transistors in continuous active regions, transistors in discontinuous active regions
and transistors in two-input active regions are mixed, in order to minimize the area
25 occupied by the device.

It is considered that the reason why the known semiconductor device has been designed in the manner as described above is based on the premise that the performance of a semiconductor device is determined by the gate length and gate width of MISFETs. However, experiments done by the present inventors have revealed that the performance of a semiconductor device provided with recent MISFETs that have been minimized is changeable depending not only on the gate length and gate width of the MISFETs but also on the layout of the active regions. More specifically, even for MISFETs having the same circuit configuration, operating speeds of the respective MISFETs vary depending on the layouts thereof. That is to say, the performance of the whole semiconductor device is also affected by the layouts.

SUMMARY OF THE INVENTION

In the present invention, attention is drawn to a characteristic of MISFETs that the operating speeds thereof vary depending on distortion occurring in the active regions. It is therefore an object of the present invention to provide a high performance semiconductor device by achieving a layout utilizing this characteristic of the MISFETs.

Specifically, a first inventive semiconductor device includes: a first discontinuous active region in which only a gate of a pMISFET is placed; a first continuous active region in which gates of three or more respective pMISFETs are arranged; and a trench isolation surrounding the first discontinuous active region and the first continuous active region, wherein gates of pMISFETs of a first type are arranged in the first continuous active region, whereas a gate of a pMISFET of a second type, which needs higher current driving capability than the pMISFETs of the first type, is placed in the first discontinuous active region.

In this device, the pMISFET of the second type which needs high current driving

capability is placed in the first discontinuous active region to which a large compressive stress is applied from the trench isolation. Accordingly, it is possible to improve the current driving capability of the pMISFET by utilizing light holes created in the valence band, thus obtaining a high performance semiconductor device.

5 The first inventive semiconductor device may further include a two-input active region which is surrounded by the trench isolation and in which gates of two respective pMISFETs are disposed, wherein gates of two respective pMISFETs of the second type are disposed in the two-input active region. Then, it is possible to suppress degradation in the performance of the pMISFETs, while reducing the area occupied by the active region of
10 the whole semiconductor device.

In such a case, a dummy gate for separation is preferably provided between the gates of the two pMISFETs of the second type. Then, it is possible to prevent interference between signals for two pMISFETs.

The first discontinuous active region is preferably designed to have a width in the
15 range greater than or equal to five times the gate length and less than or equal to 8.5 times the gate length, in the gate length direction.

The first discontinuous active region is preferably designed to have a width in the range greater than or equal to 0.6 μm and less than or equal to 1.0 μm in the gate length direction.

20 The first inventive semiconductor device may further include: a second discontinuous active region which is surrounded by the trench isolation and in which only a gate of an nMISFET is placed; and a second continuous active region which is surrounded by the trench isolation and in which gates of three or more respective nMISFETs are arranged, wherein gates of nMISFETs of the first type are arranged in the
25 second continuous active region, whereas a gate of an nMISFET of the second type, which

needs higher current driving capability than the nMISFETs of the first type, is placed in the second discontinuous active region. Then, it is possible to suppress degradation in current driving capability of the nMISFET caused by a stress from the trench isolation.

A second inventive semiconductor device includes: a discontinuous active region in
5 which only a gate of an nMISFET is placed; a continuous active region in which gates of three or more respective nMISFETs are arranged; and a trench isolation surrounding the discontinuous active region and the continuous active region, wherein gates of nMISFETs of a first type are arranged in the continuous active region, whereas a gate of an nMISFET of a second type, which needs higher current driving capability than the nMISFETs of the
10 first type, is placed in the discontinuous active region.

In this device, the nMISFETs of the second type which need high current driving capability are arranged in the continuous active region to which a small compressive stress is applied from the trench isolation. Accordingly, it is possible to suppress degradation in current driving capability of the nMISFETs caused by the stress, thus obtaining a high
15 performance semiconductor device.

The second inventive semiconductor device may further include a two-input active region which is surrounded by the trench isolation and in which gates of two respective nMISFETs are disposed, wherein gates of nMISFETs of the first type are disposed in the two-input active region.

20 The semiconductor device may further include a dummy gate provided between the trench isolation and one of the gates of the nMISFETs of the second type located at an end thereof in the continuous active region. Then, it is possible to suppress degradation in current driving capability of all the nMISFET arranged in the continuous active region.

A distance between the trench isolation and one of the gates of the nMISFETs of
25 the second type located at an end thereof in the continuous active region is preferably

greater than or equal to four times the gate length.

A gate of an nMISFET of a third type in which a drain parasitic capacitance, a channel leakage current or a gate leakage current needs to be reduced more than in the nMISFETs of the first type is preferably placed in the discontinuous active region or the two-input active region.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view showing a layout of only pMISFETs in a semiconductor device according to a first embodiment of the present invention.

FIG. 2 is a plan view showing a layout of only nMISFETs in a semiconductor device according to a second embodiment of the present invention.

FIG. 3 is a plan view showing a layout of only nMISFETs in a semiconductor device according to a third embodiment of the present invention.

FIG. 4 is a plan view showing a layout of only nMISFETs in a semiconductor device according to a fourth embodiment of the present invention.

FIG. 5 is a plan view showing a layout of only pMISFETs in a semiconductor device according to a fifth embodiment of the present invention.

FIGS. 6A and 6B are respectively a plan view showing a layout of MISFETs in discontinuous active regions and a cross-sectional view taken along the line VI-VI in FIG. 6A.

FIGS. 7A and 7B are respectively a plan view showing a layout of MISFETs in two-input active regions and a cross-sectional view taken along the line VII-VII in FIG. 7A.

FIGS. 8A and 8B are respectively a plan view showing a layout of MISFETs in a continuous active region and a cross-sectional view taken along the line VIII-VIII in FIG.

8A.

FIG. 9 is a table showing data on saturation current values I_{dsat} of pMISFETs and nMISFETs having different gate patterns.

FIGS. 10A through 10D are plan views respectively showing a gate pattern in which finger lengths at both sides of a gate are a small finger length, a gate pattern in which finger lengths at both sides of a gate are a middle finger length, a gate pattern in which finger lengths at both sides of a gate are a large finger length, and a gate pattern in which a finger length at one side of a gate is the short finger length and a finger length at the other side of the gate is the large finger length.

FIG. 11 is a plan view showing a layout of a known semiconductor device in which a large number of MISFETs are arranged.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(TYPES OF ACTIVE REGIONS AND MISFETS)

First, types of gates of respective MISFETs used in embodiments of the present invention will be described. The types of the gates are determined by the types of active regions in which the MISFETs are arranged. In the embodiments, these active regions are of three types, namely, discontinuous active regions **R10**, two-input active regions **R20**, or continuous active regions **R30**.

FIGS. 6A and 6B are respectively a plan view showing a layout of MISFETs in the discontinuous active regions **R10** and a cross-sectional view taken along the line VI-VI in FIG. 6A.

As shown in FIGS. 6A and 6B, in each of the discontinuous active regions **R10** surrounded by a trench isolation **Ris** (i.e., a region for isolating transistors), only one gate **10** including a gate insulating film **11** and a gate electrode **12** is placed. The gate **10** of a

MISFET placed in each of the discontinuous active regions **R10** is a gate facing the trench isolation **Ris** with no gate interposed therebetween at both sides thereof (hereinafter, referred to as an isolated gate). The distance between an outer side of the gate **10** of the MISFET placed in each of the discontinuous active regions **R10** and the edge of the trench isolation **Ris** which is closest to the side of the gate **10** is defined as a finger length **L10**.

On the trench isolation **Ris**, dummy gates **17** are arranged so as to increase the accuracy in patterning for gates using a line-and-space pattern.

FIGS. **7A** and **7B** are respectively a plan view showing a layout of MISFETs in the two-input active regions **R20** and a cross-sectional view taken along the line **VII-VII** in FIG. **7A**.

As shown in FIGS. **7A** and **7B**, in each of the two-input active regions **R20** surrounded by the trench isolation **Ris** (i.e., region for isolating transistors), two gates **20** each including a gate insulating film **21** and a gate electrode **22** are disposed. Each of the gates **20** of two respective MISFETs disposed in the two-input active regions **R20** is a gate facing the trench isolation **Ris** with no gate interposed therebetween only at one side thereof (hereinafter, referred to as an end gate). The distance between an outer side of each of the gates **20** disposed in the two-input active regions **R20** and the edge of the trench isolation **Ris** which is closest to the side is defined as a finger length **L20**.

FIGS. **8A** and **8B** are respectively a plan view showing a layout of MISFETs in one of the continuous active regions **R30** and a cross-sectional view taken along the line **VIII-VIII** in FIG. **8A**.

As shown in FIGS. **8A** and **8B**, in each of the continuous active regions **R30** surrounded by the trench isolation **Ris** (i.e., region for isolating transistors), three or more gates **30** each including a gate insulating film **31** and a gate electrode **32** are arranged. The gates **30** of the three or more respective MISFETs arranged in each of the continuous

active regions **R30** are end gates facing the trench isolation **Ris** with no gates interposed therebetween only at one side thereof or gates facing other gates with no trench isolation **Ris** interposed therebetween at both sides thereof (hereinafter, referred to as intermediate gates).

5 The distance between an outer side of one of the gates **30** located at an end thereof in each of the continuous active regions **R30** and the edge of the trench isolation **Ris** which is closest to the side is defined as a finger length **L30**.

FIG. 9 is a table showing data on saturation current values **Idsat** of p-channel type MISFETs (hereinafter, referred to as pMISFETs) and n-channel type MISFETs
10 (hereinafter, referred to as nMISFETs) having gate patterns shown in FIGS. 10A through 10D. The saturation current values **Idsat** shown in FIG. 9 are represented as ratios when the saturation current values **Idsat** of the pMISFET and nMISFET each having a gate pattern shown in FIG. 10A are taken as "1". FIG. 10A shows a gate pattern in which finger lengths at both sides of a gate are a small finger length **Ls** (= 0.24 μm). FIG. 10B
15 shows a gate pattern in which finger lengths at both sides of a gate are a middle finger length **Lm** (= 0.4 μm). FIG. 10C shows a gate pattern in which finger lengths at both sides of a gate are a large finger length **Lw** (= 1.0 μm). FIG. 10D shows a gate pattern in which a finger length at one side of a gate is the small finger length **Ls** (= 0.24 μm) and a finger length at the other side of the gate is the large finger length **Lw** (= 1.0 μm). In any of the
20 cases shown in FIGS. 10A through 10D, dummy gates are arranged at equal intervals.

FIG. 9 and FIGS. 10A through 10D indicate the following facts. The saturation current value **Idsat** of a pMISFET when finger lengths at both sides of the gate are the small finger length **Ls** as shown in FIG. 10A is the largest of all the saturation current values of the pMISFETs. The saturation current value **Idsat** of a pMISFET when finger
25 lengths at both sides of the gate are the large finger length **Lw** as shown in FIG. 10C is the

smallest. The saturation current value **Idsat** of a pMISFET when finger lengths at both sides of the gate are the middle finger length **Lm** as shown in FIG. 10B is almost the intermediate value between the above two values. Insofar as the data shown in FIG. 9 is concerned, the saturation current value **Idsat** of a pMISFET when a finger length at one side of the gate is the small finger length **Ls** and a finger length at the other side is the large finger length **Lw** as shown in FIG. 10D is the same as the saturation current value **Idsat** of the pMISFET shown in FIG. 10C.

Accordingly, it is preferable that pMISFETs are placed in the discontinuous active regions **R10**. In such a case, It is more preferable that the finger length is designed to be in the range greater than or equal to four times the gate length and less than or equal to 8.5 times the gate length. The discontinuous active regions **R10** are preferably designed to have a width greater than or equal to 0.6 μm and less than or equal to 1.0 μm in the gate length direction.

With respect to nMISFETs, the saturation current value **Idsat** of an nMISFET when finger lengths at both sides of the gate are the middle finger length **Lm** as shown in FIG. 10B and the saturation current value **Idsat** of an nMISFET when finger lengths at both sides of the gate are the large finger length **Lw** as shown in FIG. 10C are almost the same and the largest of all the saturation current values. The saturation current value **Idsat** of an nMISFET when a finger length at one side of the gate is the small finger length **Ls** and a finger length at the other side is the large finger length **Lw** as shown in FIG. 10D is the second largest. The saturation current value **Idsat** of an nMISFET when finger lengths at both sides of the gate are the small finger length **Ls** are the smallest.

Accordingly, it is preferable that the nMISFETs are arranged in the continuous active regions **R30**. In such a case, it is more preferable that the finger length is designed to be in the range greater than or equal to four times the gate length.

EMBODIMENT 1

FIG. 1 is a plan view showing a layout of only pMISFETs in a semiconductor device according to a first embodiment of the present invention. A layout of nMISFETs according to this embodiment is not limited to a specific one. Therefore, the nMISFET are not shown and the description thereof is omitted.

As shown in FIG. 1, the active regions of the pMISFETs of this embodiment are arranged in an n-well 40. In the n-well 40, discontinuous active regions **R10p** in each of which only a high-driving-capability gate **10ph** of a pMISFET is placed; two-input active regions **R20p** in each of which high-driving-capability gates **20ph** of two respective pMISFETs are disposed; and continuous active regions **R30p** in which normal gates **30pu** of three or more respective pMISFETs are continuously arranged, are provided. Dummy gates **17** are arranged on a trench isolation **Ris** of the semiconductor device so as to increase the accuracy in patterning for gates using a line-and-space pattern.

The pMISFETs of the semiconductor device of this embodiment are characterized by the following configuration.

High-driving-capability gates, which require high current driving capability, are arranged in the discontinuous active regions **R10p** and the two-input active regions **R20p** and are laid out such that a relatively large stress is applied from the trench isolation **Ris** to the high-driving-capability gates, as will be described later. Specifically, the gates of the pMISFETs which need high current driving capability are the high-driving-capability gates **10ph** placed in the discontinuous active regions **R10p** (isolated gates) or the high-driving-capability gates **20ph** disposed in the two-input active regions **R20p** (end gates). A finger length **L10p** with respect to each of the high-driving-capability gates **10ph** in the discontinuous active regions **R10p** and a finger length **L20p** with respect to each of the

high-driving-capability gates **20ph** in the two-input active regions **R20p** are both the small finger length **Ls** shown in FIG. **10A**.

On the other hand, the gates of pMISFETs which do not require high current driving capability are arranged in the continuous active regions **R30p** and laid out such that
5 a stress is less applied from the trench isolation **Ris** to the gates. Specifically, the gates of the pMISFETs which do not need high current driving capability are the normal gates **30pu** (end gates or intermediate gates) arranged in the continuous active regions **R30p**. A finger length **L30p** which is the shortest of the finger lengths with respect to one of the normal gates **30pu** located at an end thereof in each of the continuous active regions **R30p**
10 is the small finger length **Ls** shown in FIG. **10D**.

(EFFECT OF EMBODIMENT 1)

An effect of a compressive stress applied from the trench isolation to a channel (hereinafter, referred to as a trench isolation stress) on transistor characteristics is that even
15 transistors having the same gate length and the same gate width exhibit different performances. Hereinafter, a description will be given of effects of the trench isolation stress on transistor characteristics. The trench isolation stress causes a lattice distortion in the channel of a MISFET. Accordingly, in an nMISFET, the lattice distortion is likely to cause the effective mobility of carriers in its channel to decrease so that the performance of
20 the nMISFET is degraded. On the contrary, in a pMISFET, the trench isolation stress applied in the gate length direction eliminates degeneration in the valence band, thereby creating heavy holes and light holes. These light holes have a small effective mass, so that the effective mobility in the pMISFET is likely to increase.

As a result, as shown in FIG. **9** and FIGS. **10A** through **10D**, when the trench
25 isolation stress applied in the gate length direction is large, the current driving capability of

the pMISFET improves.

As described above, in the semiconductor device of this embodiment, the high-driving-capability gates **10ph** or **20ph** are provided in the discontinuous active regions **R10p** or the two-input active regions **R20p**, so that pMISFETs with high driving capability
5 can be obtained by utilizing light holes created due to lattice distortion.

In general, as a semiconductor device for use in a logic circuit, a so-called CMOS device provided with an nMISFET and a pMISFET is used. In this case, the carrier mobility in the pMISFET utilizing holes as carriers is much lower than in the nMISFET utilizing electrons as carriers. Accordingly, improvement in the performance of the
10 pMISFET will contribute a large part in improving the performance of the whole CMOS device. In view of this, the present embodiment makes it possible to obtain a high performance CMOS device.

In this embodiment, high-driving-capability gates are also provided in the two-input active regions **R20p**. Alternatively, high-driving-capability gates may be provided
15 only in the discontinuous active regions **R10p**. In such a case, as found from FIG. 9 and FIGS. 10A through 10D, the effects of the present invention can be more noticeably achieved.

EMBODIMENT 2

20 FIG. 2 is a plan view showing a layout of only nMISFETs in a semiconductor device according to a second embodiment of the present invention. A layout of pMISFETs according to this embodiment is not limited to a specific one. Therefore, the pMISFET are not shown and the description thereof is omitted.

As shown in FIG. 2, the nMISFET of this embodiment are arranged in a p-well **41**.
25 In the p-well **41**, discontinuous active regions **R10n** in each of which only a normal gate

10nu of an nMISFET is placed; two-input active regions **R20n** in each of which normal gates **20nu** of two respective nMISFETs are disposed; and continuous active regions **R30n** in each of which high-driving-capability gates **30nh** of three or more respective nMISFETs are continuously arranged without being separated by a trench isolation **Ris** of the semiconductor device, are provided. Dummy gates **17** are arranged on the trench isolation **Ris** so as to increase the accuracy in patterning for gates using a line-and-space pattern.

The nMISFETs of the semiconductor device of this embodiment are characterized by the following configuration.

The gates of the nMISFETs which require high current driving capability are arranged in the continuous active regions **R30n** and configured such that a trench isolation stress is less applied to the gates. Specifically, the gates of the nMISFETs which need high current driving capability are the high-driving-capability gates **30nh** arranged in the continuous active regions **R30n** (i.e., end gates or intermediate gates). A finger length **L30n**, which is the shortest of the finger lengths with respect to one of the high-driving-capability gates **30nh** located at an end thereof in each of the continuous active regions **R30n**, is the small finger length **Ls** shown in FIG. 10D.

On the other hand, the gates of nMISFETs which do not need high current driving capability are arranged in the discontinuous active regions **R10n** and the two-input active regions **R20n** and laid out such that a relatively large stress is applied from the trench isolation **Ris** to the gates. Specifically, the gates of the nMISFETs which do not need high current driving capability are the normal gates **10nu** (isolated gates) arranged in the discontinuous active regions **R10n** or the normal gates **20nu** (end gates) disposed in the two-input active regions **R20n**. A finger length **L10n** with respect to each of the normal gates **10nu** in the discontinuous active regions **R10n** and a finger length **L20n** with respect to each of the normal gates **20nu** in the two-input active regions **R20n** are both the small

finger length **Ls** shown in FIG. **10A**.

In addition, nMISFETs whose drain parasitic capacitance needs to be reduced, or MISFETs in which a channel leakage current or a gate leakage current in the OFF state is not permitted are preferably arranged in the discontinuous active regions **R10n** or the two-
5 input active regions **R20n**.

(EFFECT OF EMBODIMENT 2)

As described above, in an nMISFET, the effective mobility of carriers in its channel is likely to decrease so that the performance thereof is degraded.

10 Accordingly, as shown in FIG. **9** and FIGS. **10A** through **10D**, when the trench isolation stress in the gate length direction is large, the current driving capability of the nMISFET degrades.

As described above, in the semiconductor device of this embodiment, the high-driving-capability gates **30nh** are arranged only in the continuous active regions **R30n**.
15 Therefore, decrease in driving capability resulting from lattice distortion can be suppressed, thus obtaining an nMISFET with higher driving capability than that of the known semiconductor device. Accordingly, this embodiment makes it possible to obtain a high performance CMOS device including an nMISFET with high driving capability.

In addition, in the semiconductor device of this embodiment, the gates of
20 nMISFETs whose drain parasitic capacitance needs to be reduced, or the gates of nMISFETs in which a channel leakage current or a gate leakage current in the OFF state is not permitted may be arranged in the discontinuous active regions **R10n** or the two-input active regions **R20n**. In such a case, it is possible to obtain a semiconductor device including an nMISFET operating at high speed and having a small leakage current
25 characteristic.

(MODIFIED EXAMPLE OF EMBODIMENT 2)

In this modified example of the second embodiment, the gates of pMISFETs are laid out as shown in FIG. 1 and the gates of nMISFETs are laid out as shown in FIG. 2. In this way, the effects of both of the first and second embodiments can be achieved.

Specifically, the high-driving-capability gates of pMISFETs which need high current driving capability are arranged in the discontinuous active regions **R10p** or the two-input active regions **R20p** under a large trench isolation stress, whereas the gates of nMISFETs which need high current driving capability are arranged in the continuous active regions **R30n**. Accordingly, the current driving capability increases in any of the pMISFETs and the nMISFETs. In addition, if nMISFETs whose drain parasitic capacitance needs to be reduced as necessary or nMISFETs in which a channel leakage current or a gate leakage current in the OFF state cannot be permitted are arranged in the discontinuous active regions **R10n** or the two-input active regions **R20n**, it is possible to obtain a semiconductor device including nMISFETs operating at high speed and having a small leakage current characteristic.

EMBODIMENT 3

FIG. 3 is a plan view showing a layout of only nMISFETs in a semiconductor device according to a third embodiment of the present invention. A layout of pMISFETs according to this embodiment is not limited to a specific one. Therefore, the pMISFET are not shown and the description thereof is omitted.

As shown in FIG. 3, the nMISFET of this embodiment are arranged in a p-well **41**. In the p-well **41**, discontinuous active regions **R10n** in each of which only a normal gate **10nu** of an nMISFET is placed; two-input active regions **R20n** in each of which normal

gates **20nu** of two respective nMISFETs are disposed; and continuous active regions **R30n** in each of which high-driving-capability gates **30nh** of three or more respective nMISFETs are continuously arranged without being separated by a trench isolation **Ris** of the semiconductor device, are provided. Dummy gates **17** are arranged on the trench isolation
5 **Ris** so as to increase the accuracy in patterning for gates using a line-and-space pattern.

The nMISFETs of the semiconductor device of this embodiment are characterized by the following configuration.

The high-driving-capability gates which require high current driving capability are arranged in the continuous active regions **R30n** and configured such that a trench isolation
10 stress is less applied to the gates. In this aspect, this embodiment is the same as the second embodiment. However, in the third embodiment, one of the gates arranged in each of the continuous active regions **R30n** which is adjacent to the trench isolation **Ris** is a dummy gate **17n**. That is to say, the gates of the nMISFETs which need high current driving capability are the high-driving-capability gates **30nh** (intermediate gates) arranged in the
15 continuous active regions **R30n** except for the dummy gate **17n**. A finger length **L30n** which is the shortest of the finger lengths with respect to one of the high-driving-capability gates **30nh** adjacent to the dummy gate **17n** in each of the continuous active regions **R30n** is the middle finger length **Lm** shown in FIG. 10B.

On the other hand, the gates of nMISFETs which do not require high current
20 driving capability are arranged in the discontinuous active regions **R10n** and the two-input active regions **R20n** and laid out such that a relatively large stress is applied from the trench isolation **Ris** to the gates. Specifically, the gates of the nMISFETs which do not need high current driving capability are the normal gates **10nu** (isolated gates) placed in the discontinuous active regions **R10n** or the normal gates **20nu** (end gates) disposed in the
25 two-input active regions **R20n**. A finger length **L10n** with respect to each of the normal

gates **10nu** in the discontinuous active regions **R10n** and a finger length **L20n** with respect to each of the normal gates **20nu** in the two-input active regions **R20n** are both the small finger length **Ls** shown in FIG. 10A. In this aspect, this embodiment is the same as the second embodiment.

5 In this embodiment, the high-driving-capability gates **30nh** of nMISFETs which need high current driving capability are arranged in the continuous active regions **R30n** and the dummy gate **17n** is provided at an end of each of the continuous active regions **R30n**. Accordingly, a finger length **L30n** which is the shortest of the finger lengths with respect to one of the high-driving-capability gates **30nh** of the nMISFETs adjacent to the
10 dummy gate **17n** is the middle finger length **Lm**. As shown in FIG. 9, with respect to nMISFETs, the saturation current value **Idsat** of an nMISFET when finger lengths at the sides of the gate are the middle finger length **Lm** is much higher than the saturation current value **Idsat** of an nMISFET when one of the finger lengths at the sides of the gate is the small finger length **Ls**. Accordingly, in the semiconductor device of this embodiment,
15 decrease in current driving capability resulting from a trench isolation stress can be suppressed in all the nMISFETs whose gates are arranged in the continuous active regions **R30n**, thus obtaining a semiconductor device including nMISFETs having higher current driving capability than in the second embodiment.

20 EMBODIMENT 4

FIG. 4 is a plan view showing a layout of only nMISFETs in a semiconductor device according to a fourth embodiment of the present invention. A layout of pMISFETs according to this embodiment is not limited to a specific one. Therefore, the pMISFET are not shown and the description thereof is omitted.

25 As shown in FIG. 4, the nMISFET of this embodiment are arranged in a p-well **41**.

In the p-well **41**, discontinuous active regions **R10n** in each of which only a normal gate **10nu** of an nMISFET is placed; two-input active regions **R20n** in each of which normal gates **20nu** of two respective nMISFETs are disposed; and continuous active regions **R30n** in each of which high-driving-capability gates **30nh** of three or more respective nMISFETs
5 are continuously arranged without being separated by a trench isolation **Ris** of the semiconductor device, are provided. Dummy gates **17** are arranged on the trench isolation **Ris** so as to increase the accuracy in patterning for gates using a line-and-space pattern.

The nMISFETs of the semiconductor device of this embodiment are characterized by the following configuration.

10 The high-driving-capability gates **30nh** which require high current driving capability are arranged in the continuous active regions **R30n** and configured such that a trench isolation stress is less applied to the gates. In this aspect, this embodiment is the same as the second embodiment. However, in the fourth embodiment, a finger length **L30n** which is the shortest of the finger lengths with respect to one of the high-driving-
15 capability gates **30nh** adjacent to the trench isolation **Ris** in each of the continuous active regions **R30n** is the middle finger length **Lm** shown in FIG. **10B**.

On the other hand, the gates of nMISFETs which do not require high current driving capability are arranged in the discontinuous active regions **R10n** and the two-input active regions **R20n** and laid out such that a relatively large stress is applied from the
20 trench isolation **Ris** to the gates. Specifically, the gates of the nMISFETs which do not need high current driving capability are the normal gates **10nu** (isolated gates) placed in the discontinuous active regions **R10n** or the normal gates **20nu** (end gates) disposed in the two-input active regions **R20n**. A finger length **L10n** with respect to each of the normal gates **10nu** in the discontinuous active regions **R10n** and a finger length **L20n** with respect
25 to each of the normal gates **20nu** in the two-input active regions **R20n** are both the small

finger length **L_s** shown in FIG. 10A. In this aspect, this embodiment is the same as the second embodiment.

In this embodiment, the high-driving-capability gates **30nh** of nMISFETs which require high current driving capability are arranged in the continuous active regions **R30n** and the finger length **L30n** which is the shortest of the finger lengths with respect to one of the high-driving-capability gates **30nh** located at an end thereof is the middle finger length **L_m**. Accordingly, as in the third embodiment, decrease in current driving capability resulting from a trench isolation stress can be suppressed in all the nMISFETs arranged in the continuous active regions **R30n**, thus obtaining a semiconductor device including nMISFETs having higher current driving capability than in the second embodiment.

That is to say, the finger length **L30n** with respect to one of the gates of the nMISFETs arranged in the continuous active regions **R30n** which is located at an end thereof is designed to be in the range greater than or equal to four times the gate length, thereby achieving the same effects as those in the third embodiment, without providing any dummy gate.

EMBODIMENT 5

FIG. 5 is a plan view showing a layout of only pMISFETs in a semiconductor device according to a fifth embodiment of the present invention. A layout of nMISFETs according to this embodiment is not limited to a specific one. Therefore, the nMISFET are not shown and the description thereof is omitted.

As shown in FIG. 5, the respective active regions of the pMISFET of this embodiment are arranged in an n-well **40**. In the n-well **40**, discontinuous active regions **R10p** in each of which only a high-driving-capability gate **10ph** of a pMISFET is placed; two-input active regions **R20p** in each of which high-driving-capability gates **20ph** of two

respective pMISFETs are disposed; and continuous active regions **R30p** in each of which normal gates **30pu** of three or more respective pMISFETs are continuously arranged, are provided. Dummy gates **17** are arranged on a trench isolation **Ris** of the semiconductor device so as to increase the accuracy in patterning for gates using a line-and-space pattern.

5 The pMISFETs of the semiconductor device of this embodiment are characterized by the following configuration.

The high-driving-capability gates which require high current driving capability are arranged in the discontinuous active regions **R10p** and the two-input active regions **R20p** and laid out such that a relatively large stress is applied from the trench isolation **Ris** to the gates. Specifically, the gates of the pMISFETs which need high current driving capability are the high-driving-capability gates **10ph** (isolated gates) placed in the discontinuous active regions **R10n** or the high-driving-capability gates **20ph** (end gates) disposed in the two-input active regions **R20p**. A finger length **L10p** with respect to each of the high-driving-capability gates **10ph** in the discontinuous active regions **R10p** and a finger length **L20p** with respect to each of the high-driving-capability gates **20ph** in the two-input active regions **R20p** are both the small finger length **Ls** shown in FIG. 10A. In this aspect, this embodiment is the same as the first embodiment.

However, in this embodiment, a dummy gate **17p** for separation is provided between the two high-driving-capability gates **20ph** in each of the two-input active regions **R20p**. This is a feature of the semiconductor device of this embodiment.

On the other hand, as in the first embodiment, the gates of pMISFETs which do not require high current driving capability are arranged in the continuous active regions **R30p** and laid out such that a stress is less applied from the trench isolation **Ris** to the gates. Specifically, the gates of pMISFET which do not need high current driving capability are the normal gate **30pu** (end gates or intermediate gates) arranged in the continuous active

regions **R30p**. In addition, a finger length **L30p** which is the shortest of the gate lengths with respect to one of the normal gates **30pu** located at an end thereof in each of the continuous active regions **R30p** is the small finger length **Ls** as shown in FIG. 10D.

Accordingly, in the semiconductor device of this embodiment, the same effects as
5 those in the first embodiment are achieved. In addition, it is possible to prevent interference between signals for two pMISFETs provided in a two-input active region.